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Hydrographic conditions on Hamilton Inlet Bank (Div. 2J) in the fall of 1974

by

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Introduction

During the groundfish survey by R/V ANTON DOHRN from 29 November - 8 December 1974 in ICNAF-Division 2 J also observations on the existing hydrographic conditions have been carried out. The oceanographic data routinely obtained consist of surface - and near bottom water temperatures and salinities as well as BT-records from all fishing stations. Additionally a hydrographic section from off Seal Island across Hamilton Inlet Bank (also Canadian standard section and recommended as ICNAF-standard section) has been occupied. The distribution of stations and the location of the section are shown in Fig. 1.

Analysis of the water masses off South Labrador (ICNAF-Division 2 J)

All measurements of temperature (T) and salinity (S) were used to perform a T, S - analysis of the water masses in Division 2 J. The results, as shown in Fig. 2, reveal a mixture of two main water masses, i.e. the mixture of "Labrador Shelf Surface Water" (LSSW: $T \leq 0^{\circ}$ C; $S \leq 33$ ‰), the arctic component of the Labrador Current, and "Labrador Sea Intermediate Water" (LSIW: $T \geq 3.6^{\circ}$ C; $S \geq 34,78$ ‰), the Westgreenland component of the Labrador Current. Referring to the results of the Norwestlant Surveys 1-3, 1963 (LEE, 1968) the definitions of the water masses have been modified to a certain degree:
For the Intermediate Water (3.2° C; 34.88 ‰) which occupies the central parts of the Labrador Sea below 500 m and above the deep water (2.2° C to 2.9° C, 34.94 - 34,98 ‰) at about 2ooo m, nearly the same T,S - values were used. As for the arctic component of the Labrador Current (LSSW), it is supposed here to be less salty but warmer than the Canadian Arctic Water (-1.75° C, 33.20 ‰) due to the southerly location of the area under investigation. Assuming the T,S - characteristics of LSSW and LSIW to be valid for the region and the period of investigation, one can calculate the vertical distribution of water masses on the hydrographic section as described by HERMANN (1967). Fig. 3 shows the mean hydrographic

situation of the Hamilton Bank area:
In the eastern part as well as in the deeper regions north-east of the Hamilton Bank the LSIW was found. From the bottom of the bank (st. 32) its influence on the upper water layer increases gradually until it nearly reaches the surface at station 25.

The western part is mainly influenced by the LSSW, which covers the inner part of the bank. This water mass represents the cold core of the Labrador Current and its transition zone ($\geq$ 50 % LSSW) where the T,S - properties of this cold surface current still dominate the water column.

Thus the near bottom water on Hamilton Bank consisted during the time of investigation of a mixture between LSSW and LSIW. In the inner part the arctic component is dominating while the outer part of the bank is covered by the warmer West Greenland component of the Labrador Current.

Vertical distribution of temperature and salinity

The results of the hydrographic section are given in Fig. 4. Comparing the temperature plot with the vertical distribution of water masses (Fig. 3), one can see that the boundaries of the arctic component of the Labrador Current and its transition zone are more or less correspondent with the path of the 0° C - and 2° C - isothermes respectively.

No explanation can be given here for the mode of formation of the isolated cold, low haline water bubble at station 23. As shown in Fig.3 this water mass consists of more than 50 % LSSW.

Horizontal distribution of temperature and salinity

a) From the surface as well as from the near bottom water probes charts have been plotted, showing the horizontal distribution of the respective temperatures and salinities (Figs. 5 - 8).

   At surface level the area under investigation is dominated by the arctic component of the Labrador Current (Figs. 5, 7). Using the results of the T,S - analysis, Figs. 6, 8 show that east of the 2° C - isotherme the influence of the LSIW is larger than 50 % in the near bottom layer.

b) The BT-records were used to plot the horizontal temperature distribution at distinct levels (50 m, 100 m, 150 m , and 200 m). The results are shown in Figs. 9 - 12.

Temperature changes on the Hamilton Bank Section during 1969 - 1974

A comparison of the hydrographic data obtained in late autumn of 1969 as well as 1971 - 74 (no observations in 1970!) by R/V WALTHER HERWIG and ANTON DOHRN respectively yielded the following results:

a) T,S - analysis

The distribution of the combined T,S- values of the Hamilton Bank section as obtained during the above period of years indicates two water masses with a partial mixing within the overall salinity - and temperature range of 32.3 to 34.9 ‰ and 1.1° C to 4.7° C (Fig. 13). The T,S - characteristics of the Labrador Sea Intermediate Water (3.2° C; 34.88 ‰) and of the Canadian Arctic Water (-1.75° C; 33.2‰), as given by LEE (1968), are indicated in Fig. 13 by triangles with a dot. The combined measurements, however, yield concentrations of dots which suggest modified definitions for the Intermediate Water of t ≥ 3.6° C, S ≥ 34.78 ‰ and for the arctic component of the Labrador Current of t ≤ 0° C, S ≤ 34.0° which is supposed to be valid for the inner part of the section. The pure form of Canadian Arctic Water was never observed, probably due to the southerly location of the section.

In addition Fig. 13 shows that the highest values of temperature and salinity were obtained in 1969 (+), whereas the coldest and less salty conditions were found in 1972 (□).

b) Mean temperatures in distinct water layers (0-50 m, 50-200 m, 0-200 m).

A comparison of the mean temperatures in the three water layers of each year of observation with the corresponding mean values ($\bar{t}$) of the five years combined shows, that the hydrographic situation in late fall of 1974 occupied an average position (Fig. 14 - 16). In the upper layer the temperatures in 1974 were 0.2-0.5° C lower than $\bar{t}$, in the deeper layer 0.1-0.6° C higher over the shelf but also slightly lower over the continental slope at stations 24 and 25 (Fig. 14, 15 and table 1).

Acknowledgements

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References

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HERMANN, F., 1967 The TS-Diagram Analysis of the Water Masses over the Iceland-Faroe-Rigde and in the Faroe-Bank Channel. Rapp. P.-V. Réun. Cons. Perm. int. Explor. Mer 157, 139-149.

Table 1 : Mean temperatures ($\bar{t}$ = average 1969-74, excl. 1970) and mean temperature differences in degrees centigrade as compared to 1974 ($\bar{t}$-t) in distinct water layers on the Hamilton Bank section in late fall.

layer \ station		34	33	32	29	22	23	24	25
0- 50 m	$\bar{t}$	0	0.34	0.16	0.08	0.19	0.53	2.26	2.52
	$\bar{t}$-t	0.17	0.23	0.32	0.23	0.16	-0.01	0.4	0.45
50-200 m	$\bar{t}$	0.17	0.25	0.31	0.49	0.77	1.72	3.14	3.33
	$\bar{t}$-t	-0.09	-0.44	0.13	-0.58	-0.64	-0.13	0.13	0.16
0-200 m	$\bar{t}$	0.14	0.19	0.3	0.4	0.63	1.39	2.9	3.12
	$\bar{t}$-t	-0.05	-0.24	0.19	-0.36	-0.44	-0.01	0.2	0.25

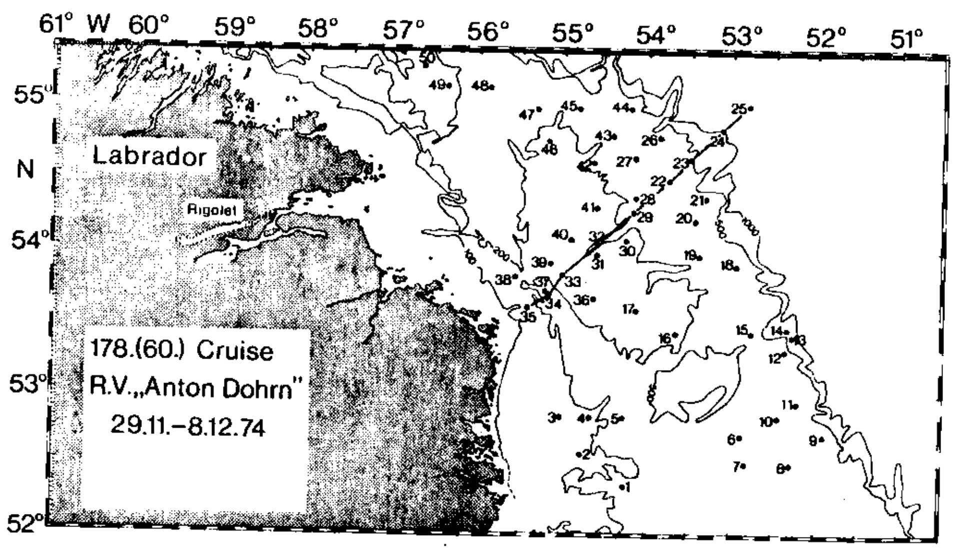


Fig. 1

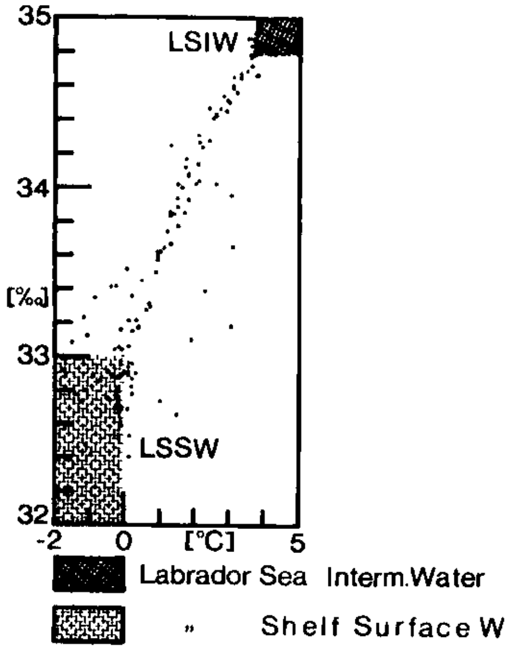


Fig. 2

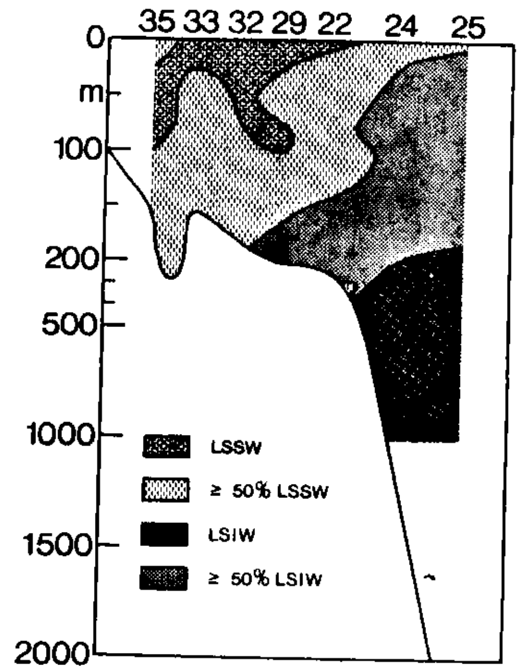


Fig. 3

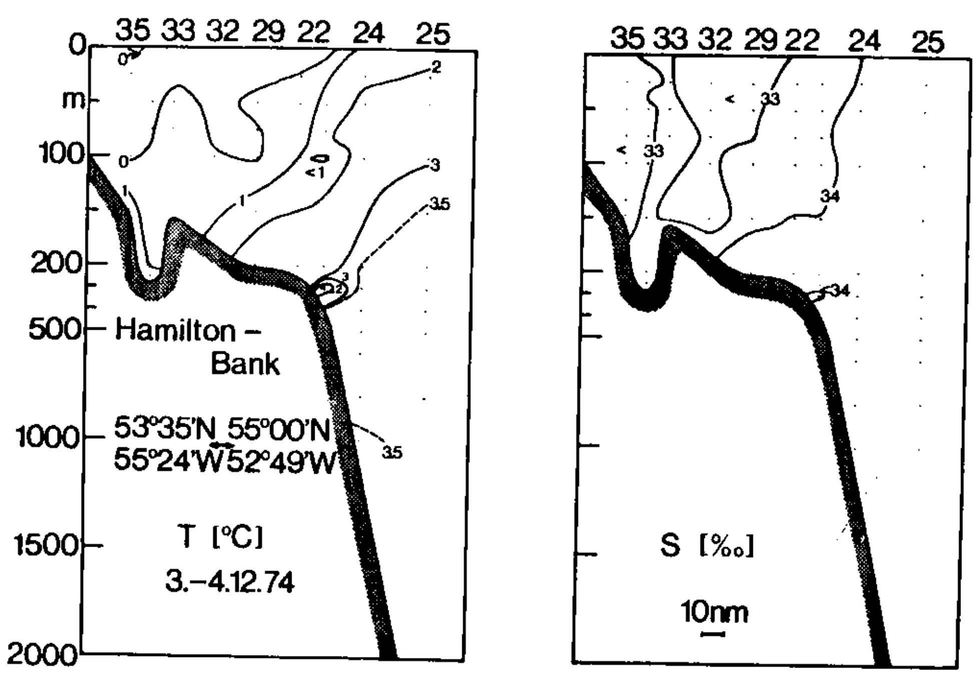
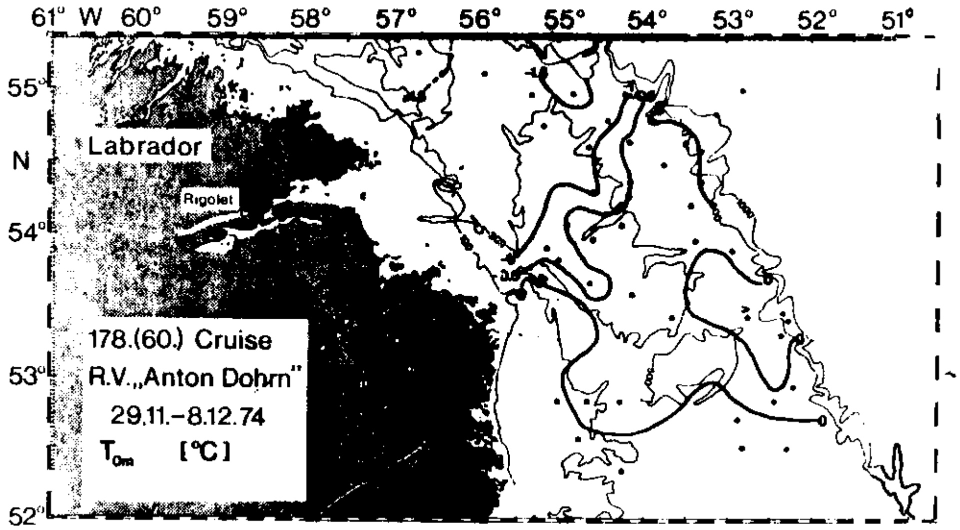


Fig. 4



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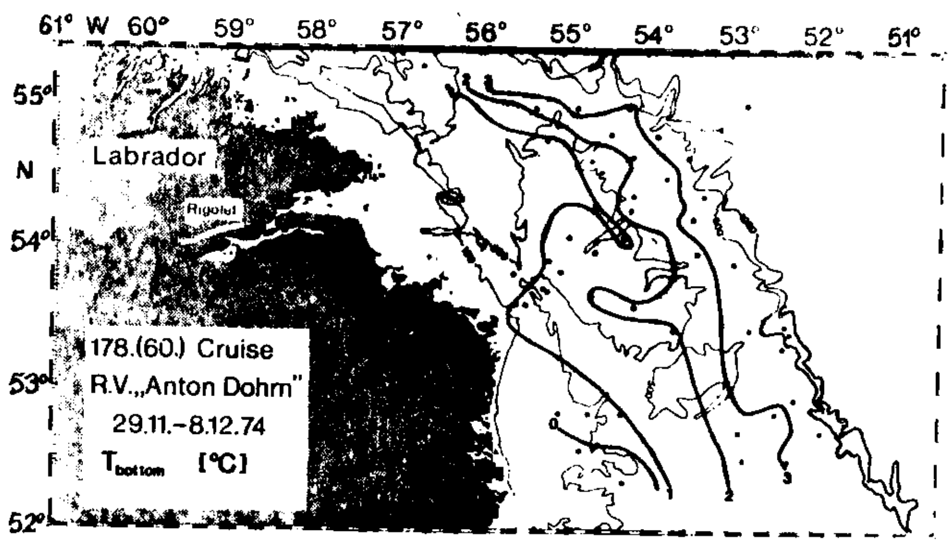
54°
53°
52°
Labrador
Rigolet
178.(60.) Cruise
R.V. „Anton Dohrn"
29.11.-8.12.74
T_{0m} [°C]

Fig. 5



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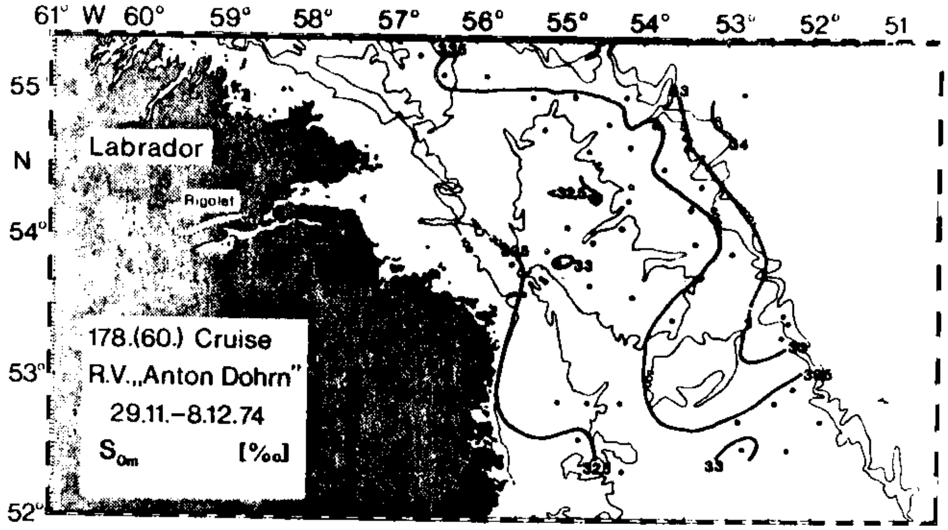
R.V. „Anton Dohrn"
29.11.-8.12.74
T_{bottom} [°C]

Fig. 6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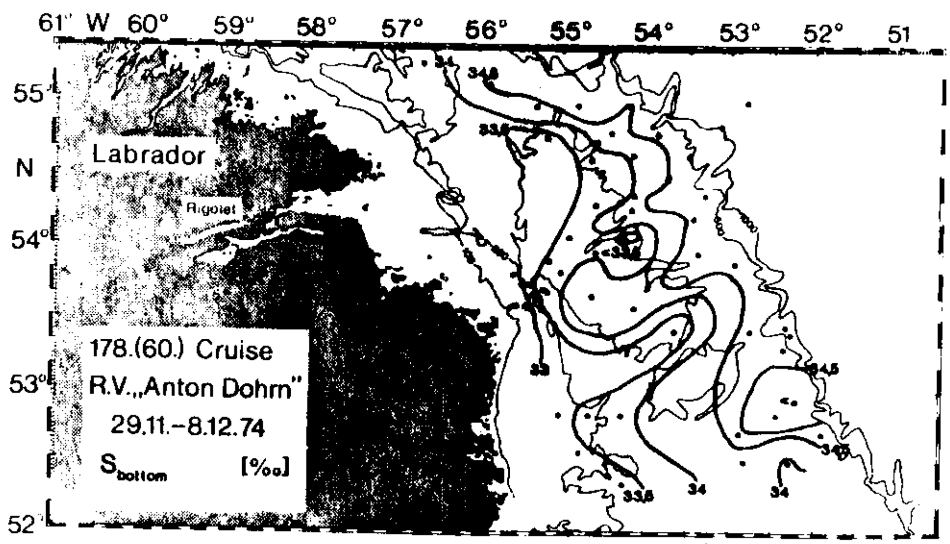
S_{0m} [‰]

Fig. 7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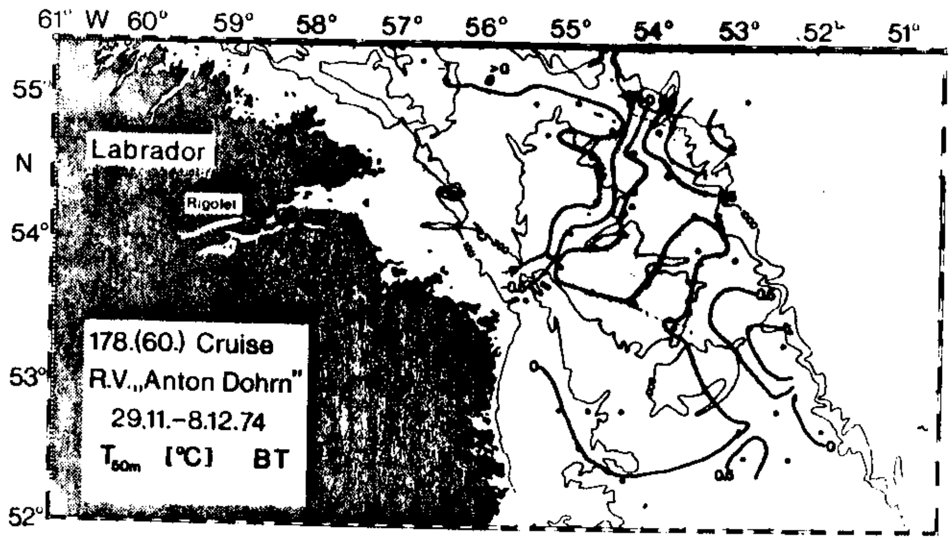
S_{bottom} [‰]

Fig. 8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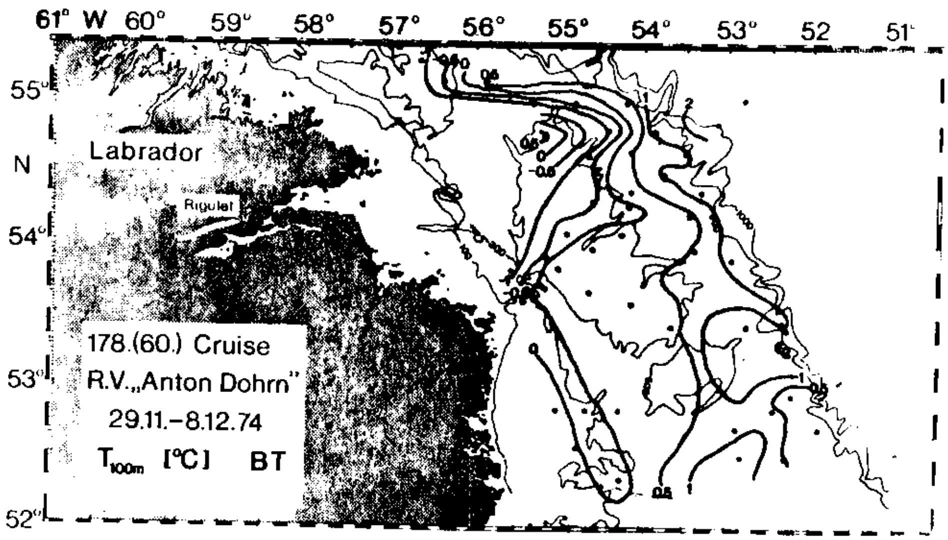
T50m [°C] BT

Fig. 9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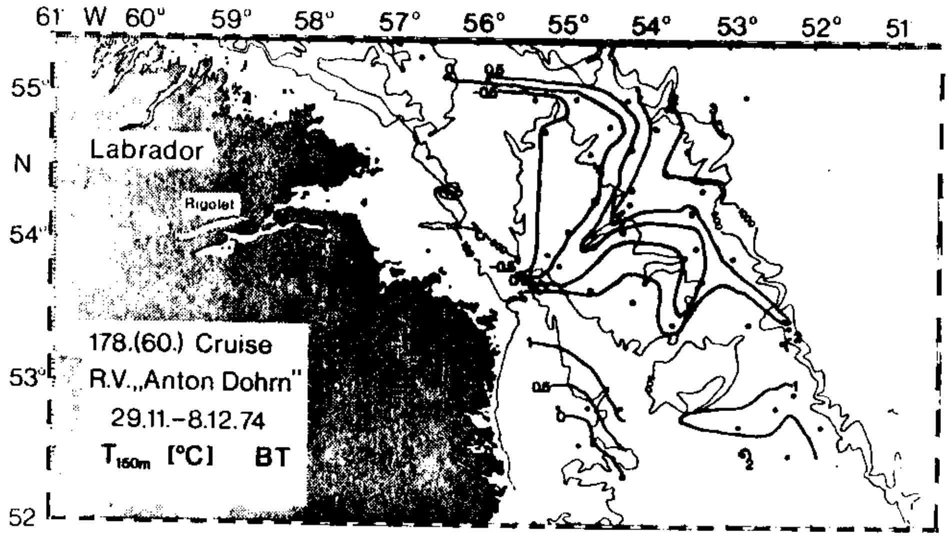
T100m [°C] BT

Fig. 10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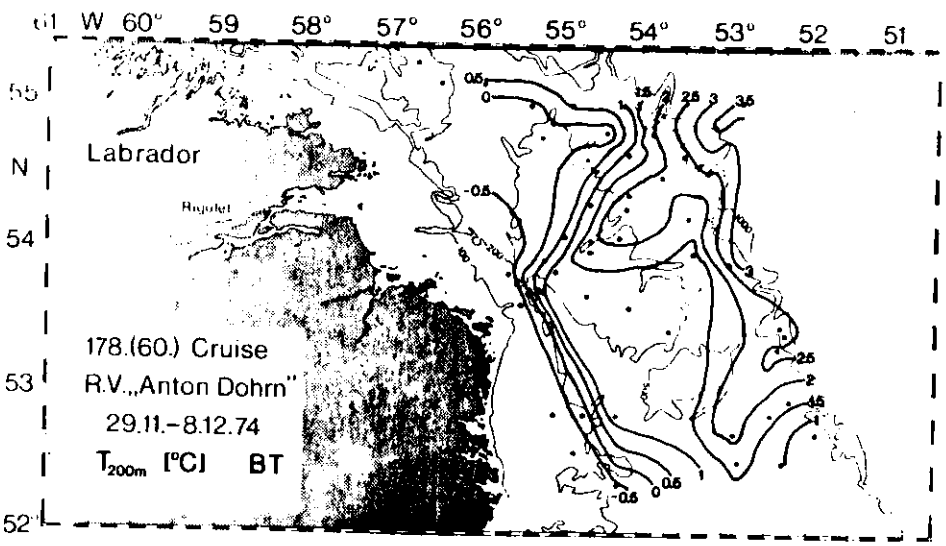
T_{150m} [°C] BT

Fig. 11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T_{200m} [°C] BT

Fig. 12

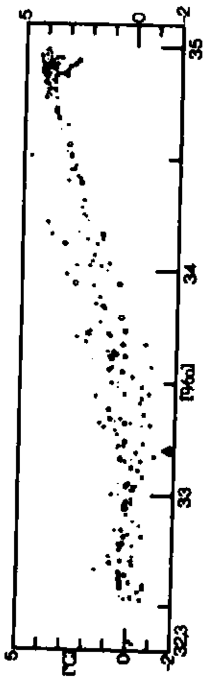

Fig. 13

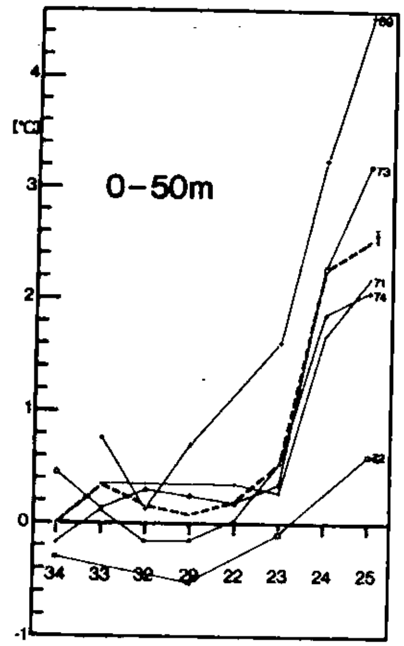

Fig. 14

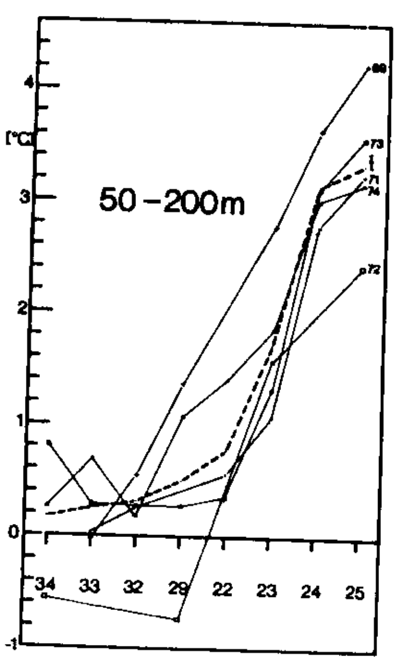

Fig. 15

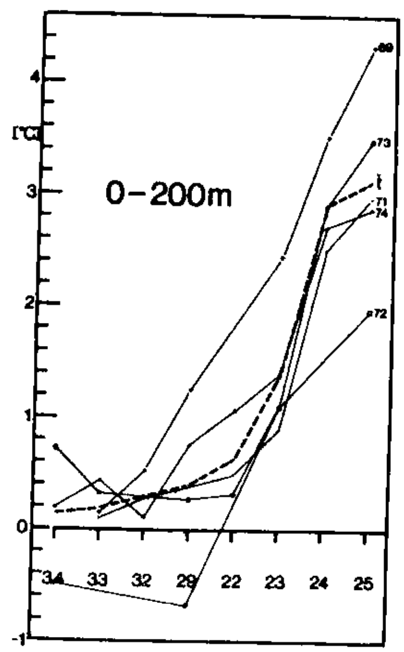

Fig. 16